BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B07B 1/46, B01D 29/07 — A1

(11) International Publication Number: WO 97/03765

(43) International Publication Date: 6 February 1997 (06.02.97)

(21) International Application Number: PCT/EP96/03103

(22) International Filing Date: 10 July 1996 (10.07.96)

(30) Priority Data:
08/504,495 20 July 1995 (20.07.95) US

(71) Applicants (*for all designated States except US*): ENVIRONMENTAL PROCEDURES, INC. [US/US]; 6829 Flintlock, Houston, TX 77240-0877 (US). LUCAS, Brian, Ronald [GB/GB]; 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): LEONE, Vincent, D. [US/US]; 12146 Burgoyne, Houston, TX 77077 (US). WALKER, Jeffrey, E. [US/US]; 107 Valleyview, Lafayette, LA 70501 (US). GRICHAR, Charles, N. [US/US]; 303 Graceland, Houston, TX 77009 (US). MCCLUNG, Guy, L. [US/US]; 8130 Vintage Creek, Spring, TX 77379 (US). SEYFFERT, Kenneth, W. [US/US]; 1019 LaMonte, Houston, TX 77018 (US).

(74) Agent: LUCAS, Brian, Ronald; Lucas & Co., 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).

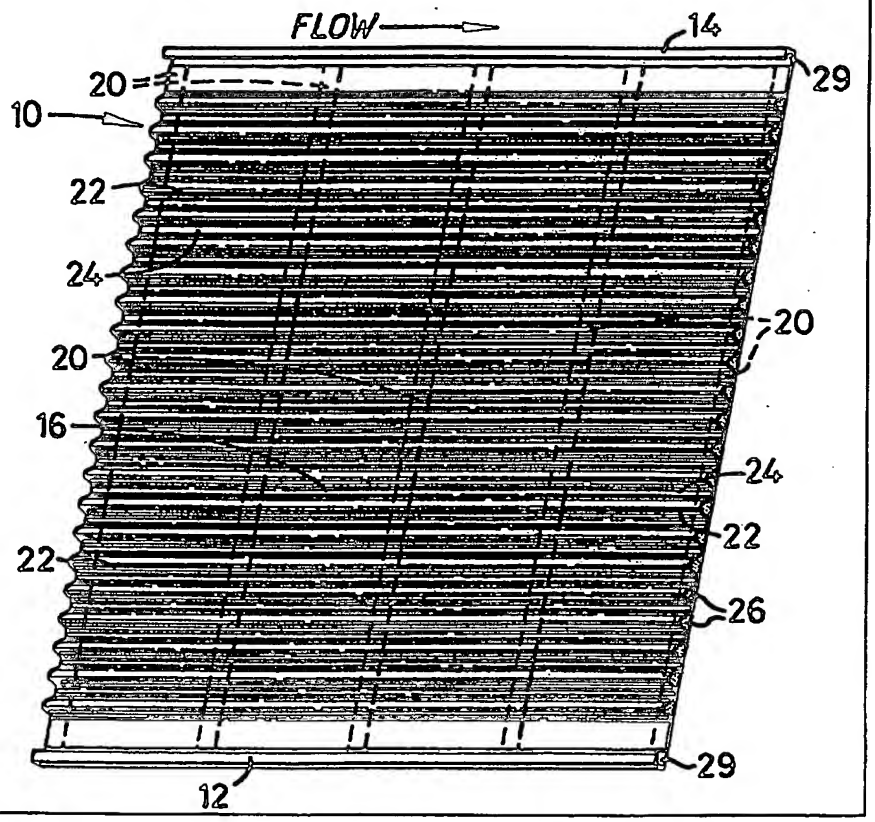
(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: SCREEN FOR USE IN VIBRATORY SHAKER DEVICE

(57) Abstract

A generally rectangular screen for a shale shaker or other vibratory device comprises a frame with sides (12, 14), undulating screen material (16) and strips (20) of metal attached to and supporting the screen material (16). The invention also comprises a vibratory device fitted with a shale shaker as aforesaid. The screens are easy and inexpensive to make and transport, are efficient and are consumable.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

SCREEN FOR USE IN VIBRATORY SHAKER DEVICE

FIELD OF THE INVENTION

The present invention relates to a screen for use in a vibratory shaker device, and to a shale shaker or other vibratory shaker device provided with one or more of the screens as aforesaid. The screens may be generally flat, or they may be non-flat and are usually, but not exclusively, rectangular in shape.

BACKGROUND TO THE INVENTION

The need for solids control in drilling mud used in hydrocarbon well drilling is well known. Drilling mud is typically a mixture of clay, water and various additives. It is pumped down through a hollow drill string (pipe, drill collar, bit, etc.) into a well being drilled and exits through holes in a drill-bit. The mud picks up rock cuttings and other solids from the well and carries them upwardly away from the bit and out of the well in a space between the well walls and the drill string. If drilled solids are not removed from the mud used during the drilling operation, recirculation of the drilled solids can give rise to weight, viscosity and gel problems in the mud, as well as increasing wear on mud pumps and other mechanical equipment used for drilling. Therefore, at the top of the well, the solids-laden mud is discharged over a shale shaker, which is a device which typically has a series of screens arranged in tiered or flat disposition with respect to each other. The screens catch and remove solids from the mud as the mud passes through them. The prior art discloses a wide variety of screens for shale shakers, and of vibratory shaker devices which use them.

In some shale shakers a fine screen cloth is used with the vibrating screen. The screen may have two or more layers of screen cloth. It is known that the layers may be bonded together, and that one or more supports or

a perforated or apertured plate may be used beneath the screen or screens. The frame of the vibrating screen is resiliently suspended or mounted upon a support and is caused to vibrate by a vibrating mechanism e.g. an unbalanced weight on a rotary shaft connected to the frame. For removal and disposal of solids, each screen may be vibrated by vibratory equipment to create a flow of trapped solids on the top surface of the screen. The fineness or coarseness of the mesh of a screen may vary depending upon mud flow rate and the size of solids to be removed.

Many screens used with shale shakers are flat or nearly flat (i.e. substantially two-dimensional). Other screens are three-dimensional and have corrugated, depressed or raised surfaces. US-A-5 417 793, 5 417 858 and 5 417 859 disclose non-flat screens for shale shakers. These screens have a lower planar apertured plate with a multiplicity of spaced-apart apertures or openings therethrough. Undulating screening material is bonded to the apertured plate at the undersides of the troughs. However, such screens have a number of disadvantages. The flow area is occluded by solid parts of the apertured plate. It is necessary either to purchase apertured plate, which is relatively expensive, or to provide for in-house perforation of a solid plate. The weight of the plate increases wear on parts such as rubber screen supports or cushions and can inhibit vibration. The large surface area of the plate requires a relatively large amount of bonding material for bonding screens to the plate. The greater the weight of the finished screen is, the more difficult and dangerous it is to handle, and the more it costs to transport.

There is a need for a supported flat or three-dimensional screen which is efficient, disposable and cost-effective, but easy and inexpensive to make, easy

to handle and relatively inexpensive to transport.

SUMMARY OF THE INVENTION

In one aspect, the invention concerns the use of relatively narrow metal or other strip material to support the screening material of a vibratory shaker screen. Thus the invention provides a screen for a vibratory shaker device comprising screening material which extends over the area of the screen and is supported by at least one relatively narrow strip.

The invention also provides a screen for a vibratory shaker, comprising:

screening material having a series of raised portions defining an undulating shape;

at least one support strip beneath said screening material and in contact therewith, the or each support strip having at least one raised part thereof with a shape corresponding to the shape of a raised portion of the screening material, and the at lest one raised part being positioned beneath and supporting the raised part.

The invention further provides a screen for a vibratory shaker device comprising:

screening material having a series of raised portions defining an undulating shape;

a plurality of support strips beneath said screening material and in contact therewith, each support strip having a plurality of raised parts thereof each with a shape corresponding to a shape of the raised portion of the screening material and each of the raised parts being positioned beneath and supporting a raised portion of the screening material;

a plurality of base strips, one base strip for each support strip with each of the support strips being positioned on a corresponding base strip, each base strip optionally having a plurality of base strip holes therethrough, and each support strip optionally having a

plurality of support strip holes therethrough.

The invention also provides a vibratory apparatus comprising a vibratory shaker device and one or more screens as aforesaid mounted on the vibratory shaker device. Thus the invention may provide a shale shaker with a frame, a screen mounting apparatus or "basket", one or more screens as described herein, and basket vibrating apparatus.

DESCRIPTION OF PREFERRED EMBODIMENTS

The screen of the invention may have one or more upper screen, screen cloth or screen mesh layers. If more than one layer is present, the layers may be bonded together at discrete points, at discrete areas or over their entire surface.

The layer or layers are mounted on frame which may have rigid supports on each of two spaced-apart sides of the layers or may be a full four-sided frame.

The support material may be of steel, aluminium or plastics. It may take the form of a strip or strips of any appropriate width and thickness, typically 1.3-7.6 cm (0.5-3") in width and 0.8-3.2mm (1/32-1/8") in thickness. It may take the form of rods of diameter 0.8-3.2mm (1/32-1/8"). The screen may use strips of different materials secured across two or more frame sides. For example, in a rectangular screen strips which run across the screen may be made of plastics and strips which run from end to end of the screen may be made of metal or vice versa. Where the frame consists of supports on each of two spaced-apart sides, a strip or strips may be directed parallel to the two sides and, where more than one strip is present, they may be spaced apart across the area of the layer or layers. The strip or strips may be directed non-parallel to the two sides, and in the case of a rectangular frame they may extend diagonally part-way or the full way from one corner to

the other.

The strips or rods may be bonded, sintered, welded or otherwise secured (herein referred to collectively as "bonded") to the layer or layers at substantially every contact point or at selected intermediate contact points. Where a three-dimensional undulating layer or layers of screen, screen cloth, screen mesh or a combination thereof is used, some or all of the troughs may be bonded to a strip or strips or portions thereof, and all or only a portion of a trough may be bonded to the strip or strips.

Some known shaker screens have a frame side with an in-turned edge which facilitates hooking of the screen e.g. to a vibrating basket. In one form of screen, a strip as described above which extends between two frame sides may also extend into and become this in-turned hooked edge. In another form of frame the strip or strips is or are secured to a portion of a side member providing a hook. To reduce or prevent fluid leakage at the interface between the hook and the strip, a steel strip may be welded to a metal hook or a non-metal strip may be bonded to a metal or non-metal hook. In a further form of frame, side members are not present and only a series of strips with hook edges supports the screening material and provides for its mounting to a shale shaker. In other embodiments in which two frame sides are used, support strips at opposite ends of the frame sides may also serve as end members across the ends of the layer which are not provided with side members. Such strips may be located at the leading and trailing edges of the layers.

Where the undulations in the layer form depressed or lower areas on or across the layer which form a generally lower path for fluid moving part-way or the whole of the way across the screen, the support strip or

strips may be positioned beneath the layer or layers at any desired angle to the direction of flow of fluid across the screen. Where the entire screen surface has undulations in the same general direction, the screen may be disposed so that fluid flows across the screen either in the same direction as the undulations or transverse to the undulations. In either case, the strip or strips beneath the layers may be in the direction of flow or transverse to it.

The strips or rods described above may have one or more projection portions formed integrally therewith or secured thereto and which project into troughs or areas of the layers. Such projecting portions may be shaped or configured to mate with the shape of a hill, valley, trough or indented area. They may be bonded to the layers at such areas, may be bonded only to the sides of such areas and not to the uppermost part of a raised portion thereof, or may be adjacent such areas without bonding thereto. If there is a series of parallel troughs or a plurality of adjacent indented areas, such projections may be provided in all such troughs or areas, in only one such trough or area, in troughs or areas only adjacent frame sides, or only in troughs or areas in the middle of the frame.

Where the screen has a series of parallel troughs, alternating flat strips and strips with one or more projections as described above can be used. Non-flat strips can be used which have a shape that corresponds to the series of troughs, e.g. with an undulating layer or layers, a corresponding undulating strip can be used. Such strips can be used instead of or in combination with flat strips as previously described.

Any strip used herein may have holes through it to facilitate fluid flow.

Any strip, combination of strips or pattern of

strips disclosed herein may be used with a generally flat ("two-dimensional") screen.

In the screens used herein, the screening material may be sintered to itself, individual screen wires may be sintered to each other, one or more layers of screen material, cloth, mesh or screen may be sintered to each other, and any screen material may be sintered to any strip disclosed herein, either entirely along its length or at selected points or areas therealong.

A screen as described in Patents US-A-5417793, 5417858 and 5417859 may be provided but with the apertured plate required by these patents deleted, and there being used instead a coarse mesh or coarse flexible mesh. This mesh may be 1mesh to 3 mesh with 2 mesh being used in a particular embodiment. Any strip, combination of strips or pattern of strips disclosed herein can be used in place of the apertured plate required by these patents, and any strip or strips disclosed herein may also be used in combination with the apertured plate required by these patents.

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figs. 1A-1D are respectively a perspective view, a side view, and end view and a bottom view of a screen according to the invention;

Figs. 2A-2C are respectively a top view, a side view and a bottom view of a second screen according to the invention;

Figs. 3-6 are bottom views of third to sixth screens according to the invention;

Figs. 7A-7D are respectively a top view, a bottom view, an end view and a side view of a seventh screen according to the invention

Figs. 8A-8C are a bottom view of part of a screen

with cross-strips, an end view of part of the screen and a further end view of part of the screen;

Figs. 9-11 are end cross-sectional views of strips for use in the present invention;

Figs. 12 and 13 are end views of parts of screens according to the invention;

Fig. 14 is a perspective view of a shale shaker according to the invention;

Figs. 15A-15B are respectively a bottom view and a side view of a further screen according to the invention

Figs. 16A-16B are respectively a top and a side view of a support strip according to the invention;

Figs. 17A-17B are top and side views of a further support strip according to the invention; and

Fig. 18 is a side view of part of a screen according to the invention.

In Figs. 1A-1D, a rectangular screen 10 has a frame with two side members 12,14 connected to strips 20 which extend between the side members 12, 14. The strips 16 provide a support for a screen 16 which may be flat but in this instance is an undulating screen with hills 22 and valleys 24. The undulations are directed transversely of the frame parallel to the side members 14 and crossing the strips 20. Plugs 26 plug the ends of the hills 22. Three-dimensional screens with plugged ends are disclosed in US Application No 08/282983, the disclosure of which is incorporated herein by reference [***Publication No to be provided or copy to be filed***]. The screen 16, and any other screen or screening material disclosed herein, represents any known mesh, screen or screens, in any combination, bonded together or unbonded. Each bottom part 28 of a valley 24 is glued by epoxy or other adhesive to the strips 20 where the strips 20 run under the screen material 16. The side members 12,14 optionally have a

hook portion 30 which facilitates screen mounting in certain shale shakers. When the screen 10 is mounted in a shale shaker, the direction of flow of drilling fluid (indicated by the arrow labelled FLOW) is generally parallel to the undulations.

Figs. 2A-2C show a rectangular screen 30 having frame side members 32,34 between which is mounted undulating screen material 31 with its folds directed longitudinally of the frame. Any strip or strip combination disclosed herein can be used in the screen 30 below the screen material 31. The undulations are defined by hilltops 36 and valleys 38 of the screen material 31. are directed generally perpendicular to the side members 32. When the screen is mounted on a shale shaker, the direction of flow of drilling fluid is across the screen 30 (as shown by the arrow labelled FLOW) and at right angles to the general direction of the hills and valleys 36,38. In one form of the screen the strips are aligned with the direction of the valleys, and in another form of screen there is a strip or rod under each valley. Instead of a strip or strips beneath the screen material 31, an apertured plate may be used, which is not an equivalent of a rod or strip or of a series of strips.

Figs. 3-6 show rectangular frames having alternative configurations of bottom support strip which can be used with any screen disclosed herein, and with any form of screening material disclosed herein. Fig 3 shows a screen 40 having undulating screening material 41 whose folds run transversely of the screen between frame side members 46,47. A bottom support structure comprises four longitudinally directed strips 42 spaced apart transversely of the frame and like those in Fig 1D and two further strips 44,45 along the ends of the screening material 41, which strips are like the previously de-

scribed strips. Fig 4 shows a screen 50 having screening material 51 within a frame defined by side members 52,54 and end members 53,55. Three support strips 56 are spaced apart along the frame and run from one end member 55 to the other end member 53. Fig. 5 shows a screen 60 having screening material 61 with folds directed transversely of the frame parallel to side frame members 62,63. The screening material 61 is supported by strips 64,65 that run along opposed sides of the frame between one side member 62 and the other side member 63 and by diagonal cross-strips 66. Strips can be used which are not full diagonals but which extend from any point on a first frame side or end member to any point on a second frame side or end member or strip which is at right angles to the first one. Fig. 6 shows a further screen 70 with screening material 71 whose undulations run transversely of the frame. The screen has side members 72,73 and end strips 76. Three strips 74 are spaced apart at intervals longitudinally of the frame and run transversely of the frame from one end strip 76 to the other. Four strips 75 are spaced apart at intervals transversely of the frame and run from one side member 72 to the other side member 73.

Figs. 7A-7D show a screen 80 having side members 82,83 between which is secured screening material 81. The frame sides include hooks 84. A rigid metal sheet 85 having a plurality of openings therethrough provides bottom support. The screening material is undulating with hilltops 86 and valleys 87. The screen 80 is placed in a shale shaker so that the direction of flow of drilling fluid across the screen (as shown by the arrow marked FLOW) is transverse to the general direction of the hills and valleys. A support strip or strips as disclosed herein may be used with this screen. An opening 88 at the end of each undulating section of the

screening material 81 may be closed off by initially applying an excess of screening material so that a portion thereof extends beyond what will be the final outer boundary of the screening material. The excess portion is cut, folded back over the opening to close it off, and then secured in place with adhesive or welding.

Figs 8A-8C show a bottom strip support assembly 90 for a screen according to the present invention. A plurality of strips 91 extend between and are secured to frame sides 92 and 93. As shown in Fig 8B, a strip 91 is welded along line 94 to part of a screen hook 95. The weld is sized and configured to prevent leakage at the hook/strip interface. A sleeve 96 made of galvanised metal encases the hook for added strength and protection. The strips 91 in Fig 8A are 0.8-3.2cm (1/32-1/8") thick.

Fig. 9 shows a screen support strip 100 having hilltops 101 and valleys 103 for corresponding to similar hills and valleys in a screen or screening material to which the strip is applied.

Fig. 10 shows a further form of screen support strip 110 which comprises a bottom strip 111 which is flat and an upper strip 112 which is undulating and is fixed to the bottom strip 111. The undulating strip 112 has hilltops 113 and valleys 114 for corresponding to a screen or screening material with similar hills and valleys.

Fig. 11 shows a further support strip 120 which resembles the support strip 110 but has fewer projecting portions 125 which are spaced apart from one another so that when a screen with multiple troughs or indentations is supported by the strip 120, only every other trough or indentation in the screen or screening material is entered by a projecting portion 125. The projections 125 bay be disposed as required to support a particular

trough, number of troughs or pattern of troughs. The support strip 120 comprises a lower strip 121 which is flat and carries the projecting portions 125.

Fig. 12 shows a screen 130 having screening material 131 (which may be any screen or screening material disclosed herein) supported by a support strip 132. The support strip has a flat bottom strip 133 and an undulating strip 124 secured thereto. The screening material 131 may rest on the undulating strip 134, some or all of which may be bonded to the screening material.

Fig. 13 shows a screen 140 which comprises screening material 141 which may be any screen or screening material disclosed herein. The material 141 is supported by support strip 142 which comprises a flat lower strip 143 which carries projecting strip portions 144 spaced apart from one another and secured to the upper face of the strip 143. The material 141 is undulating and the projections 144 project up into the hills formed in the screening material. In any embodiment of the invention in which part of a support strip projects up into a raised part of a screen, the projecting strip may be connected to, adhesively bonded to, or welded to the screen at any selected point, line, points or lines in the raised screen part. As shown in Fig 13, the projecting strip portions are not bonded to, connected to or welded to the tops 145 of the screening material 141; nor are they bonded to, welded to or connected to lower portions 146 of the raised parts of the screening material 141. Alternatively the projecting strip portions 144 may be bonded to, connected to or welded to only the tops 145 of the raised parts of the screening material and/or to the lower portions 146.

In Fig. 14, a shale shaker 210 according to the invention has a screen 220 (with screen material, screening cloth or screening mesh as desired) mounted on

a vibratable screen mounting apparatus or "basket" 212. The basket 212 is mounted on springs 214 which are supported from a frame 216. Only two of the springs are shown, and the other two are on the side of the shaker which is not seen in Fig. 14. The basket 212 is vibrated by a motor 202 and connected vibrating apparatus 218 which is mounted on the basket 212 and which brings about vibration of the basket and screens. An elevator apparatus 208 provides for raising and lowering an end of the basket 212.

Figs. 15A-15B show a screen 250 which resembles the screen in Fig 1D except that it has no side members. It has a plurality of bottom support strips, each of which has two upper in-turned edges formed into a mounting hook 254. Undulating screening material 256 is bonded to the strips 252.

Figs 16A-16B show a support strip 260 having a flat lower strip 262 carrying an undulating upper projecting strip 264 which is narrower in width than the strip 262. Any of the previously described support strips formed of an upper strip carried by a flat lower strip may also have an upper strip that is narrower in width than the lower strip. The strip of Figs 17A-17B is similar and discloses a support strip 270 formed of a lower strip 272 and an upper strip 274 secured to the lower strip. A series of openings is provided through the lower strip 262 to permit fluid flow, and a series of openings 278 is also provided through the upper strip 274. Any strip or rod disclosed herein may have holes therethrough to promote fluid flow. Any strip or rod disclosed herein with an upper projecting portion and a lower strip or rod may have holes in the upper strip or rod, the lower strip or rod, or both to promote fluid flow.

Fig. 18 disclosed an improvement in screens with upper screening material and a lower rigid perforated

metal sheet or apertured plate, including but not limited to improvements for screens as disclosed in Patent No's US-A- 5417793, 5417858 and 5417859. A screen 280 with screening material 281 has a lower apertured plate 282 as disclosed e.g. in the three listed patents. Upper projecting strips 284 are secured to the lower apertured plate 282. The upper projecting strips 284 may or may not be bonded to the screening material 281 and may or may not have holes therethrough. The screening material may be bonded to itself, and/or to any apertured plate, strip or rod. Any upper projecting rod, strip, combination of strips or rods, or pattern of strips or rods disclosed herein may be used with screens with a lower apertured plate, including but not limited to those disclosed in the three listed patents.

It will be appreciated that modifications may be made to the embodiments described herein without departing from the invention.

CLAIMS

1. A screen for a vibratory shaker device comprising screening material which extends over the area of the screen and is supported by at least one relatively narrow strip.

2. The screen of Claim 1, which is rectangular when viewed in plan.

3. The screen of Claim 2, wherein the screening material is formed to define hills and valleys.

4. The screen of Claim 3, wherein the hills and valleys run parallel to the longer dimension of the frame.

5. The screen of Claim 3, wherein the hills and valleys run parallel to the shorter dimension of the frame.

6. The screen of any of Claims 2-5, wherein a plurality of support strips run parallel to the longer dimension of the frame and are spaced apart in the shorter dimension of the frame.

7. The screen of any of Claims 2-6, wherein a plurality of support strips run parallel to the shorter dimension of the frame and are spaced apart in the longer dimension of the frame.

8. The screen of any of Claims 2-7, wherein a plurality of support strips run diagonally of the frame.

9. The screen of any of Claims 2-8, wherein ends of the frame are hooked.

10. The screen of Claim 9, wherein the hooks are defined by inturned ends of the support strips.

11. The screen of Claim 9, wherein the hooks are defined in frame side members with inturned edges.

12. The screen of any preceding claim, wherein the strips are adhesively attached to the screening material.

13. The screen of any preceding claim, wherein the or each support strip is 1.2-7.5cm (0.5-3") in width and 0.8-3.2mm (1/32-1/8") in thickness.

14. A screen for a vibratory shaker, comprising screening material having a series of raised portions defining an undulating shape, and at least one support strip beneath said screening material and in contact therewith, said at least one support strip being 1.2-7.5cm (0.5-3") in width and 0.8-3.2mm (1/32-1/8") in thickness, and said at least one support strip having at least one raised part thereof with a shape corresponding to the shape of a raised portion of the screening material, said at least one raised part being positioned beneath and supporting said raised portion.

15. The screen of Claim 14, wherein the support strip has a plurality of raised parts each corresponding to the shape of a raised portion of the screening material, and each raised part being positioned beneath and supporting a raised portion of the screening material.

16. The screen of Claim 15, wherein one raised part is positioned beneath and supports each raised portion of the screening material.

17. The screen of Claim 14, 15 or 16, wherein the screening material comprises a plurality of screening layers one on top of another.

18. The screen of Claim 17, wherein the screening layers are adhesively bonded to each other.

19. The screen of any of Claims 14-18, wherein at least one support strip has a plurality of holes therethrough.

20. The screen of any of Claims 14-19, further comprising a base strip for the or each support strip, the or each support strip being positioned on the or each base strip.

21. The screen of Claim 20, wherein each base strip has base strip holes therethrough.

22. The screen of Claim 21, wherein each support strip has support strip holes therethrough.

23. The screen of any of Claims 14-22, wherein each

raised portion of screening material has a top inner surface and a bottom inner surface, and the or each raised part of the or each support strip contacts only the top inner surface of the raised portion.

24. The screen of Claim 14, wherein each raised portion of screening material has an inner surface, and the or each raised part of the or each support strip contacts the inner surface of the raised portion of the screening material along substantially all of the length of the at least one raised part.

25. The screen of Claim 14, further comprising an apertured plate beneath the screening material and at least one support strip on the apertured plate.

26. A vibratory shaker device provided with one or more screens as claimed in any preceding claim.

27. The device of Claim 26, wherein the screen is formed with undulations and is so positioned in the device that material flow is generally parallel to the undulations.

28. The device of Claim 26, wherein the screen is formed with undulations and is so positioned in the device that material flow is generally perpendicular to the undulations.

FIG.1A

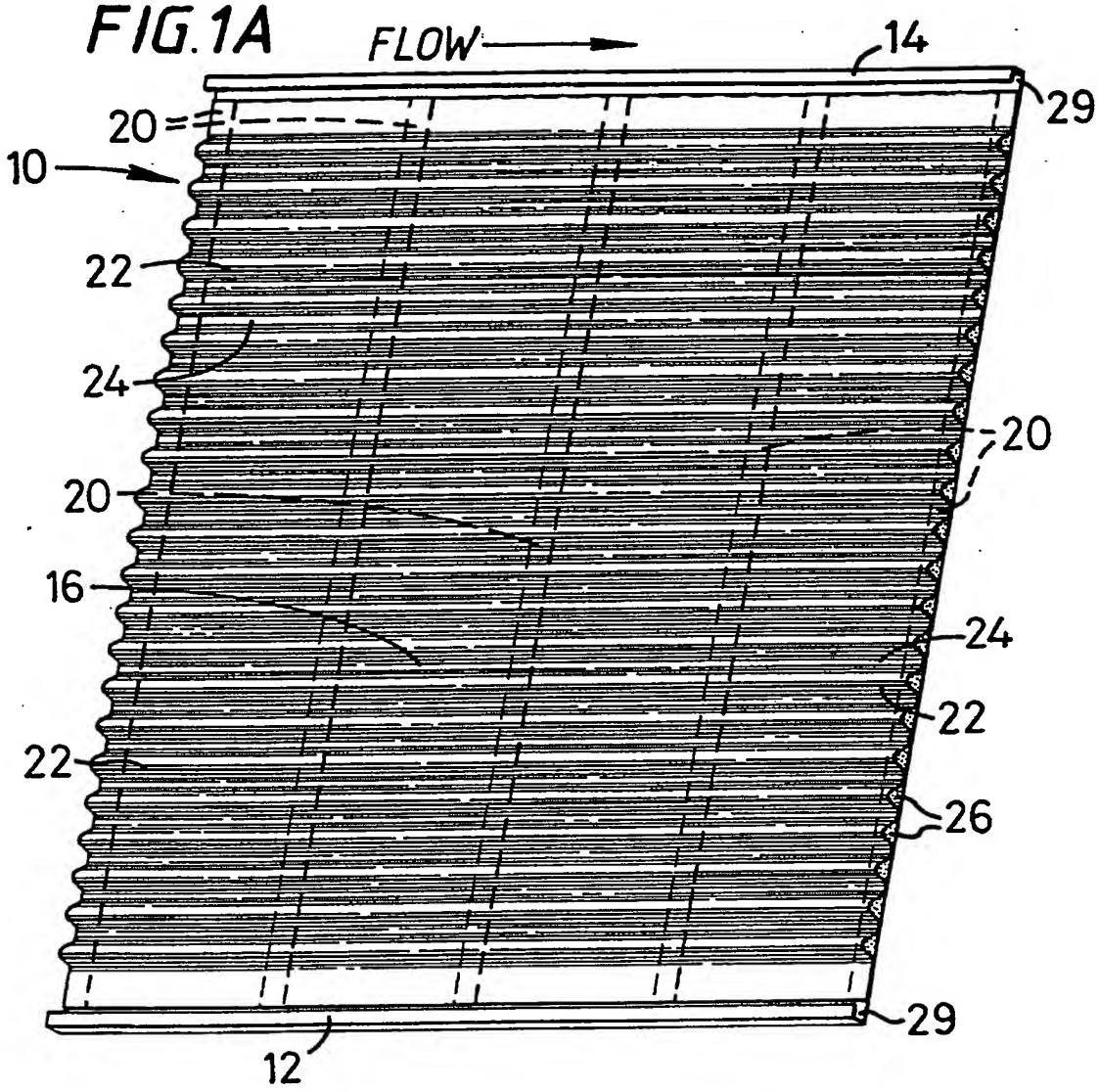
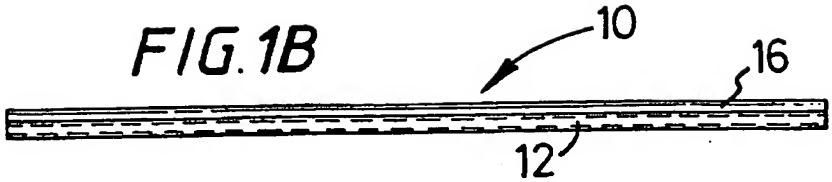


FIG.1B



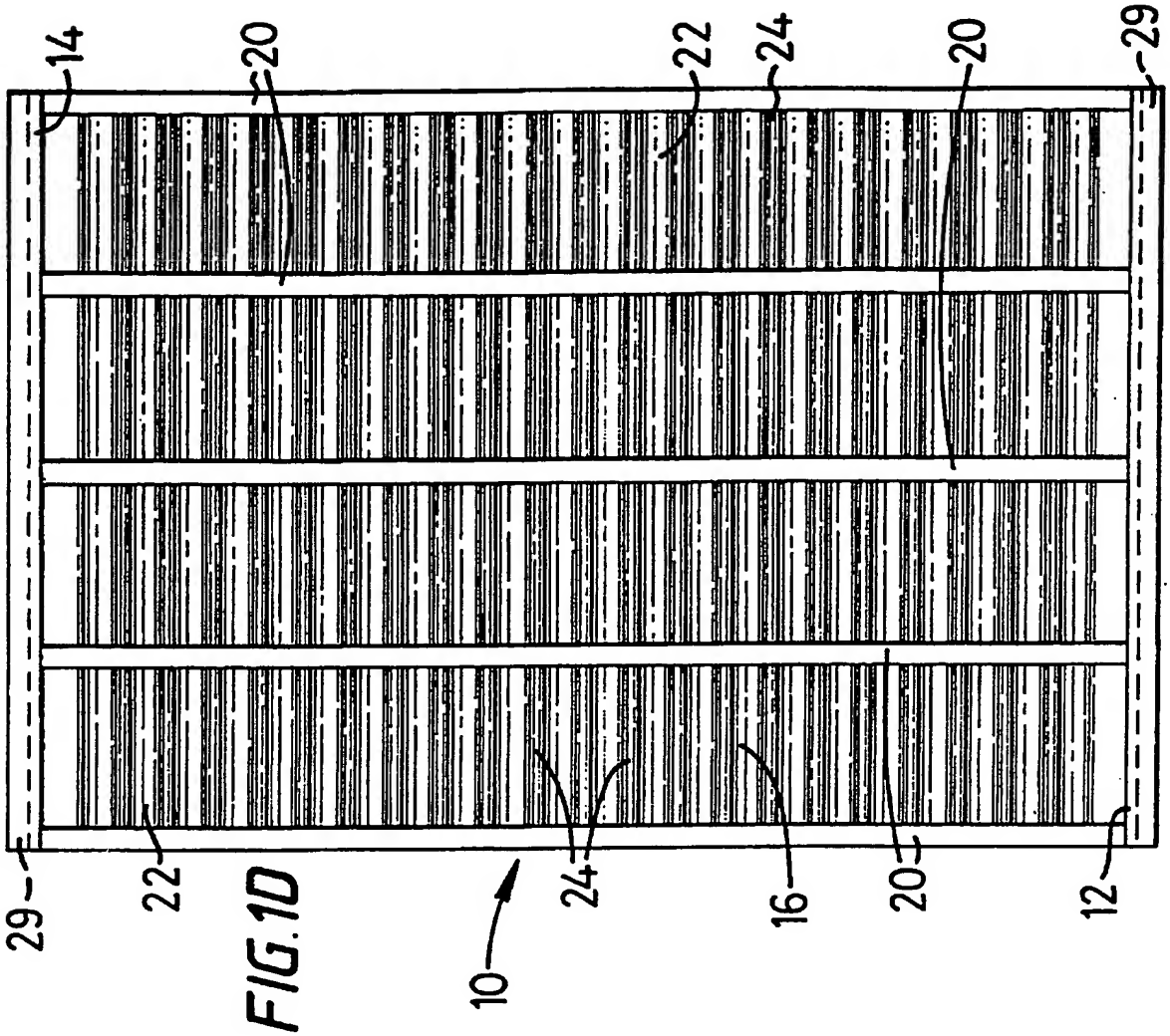

14
20
22
24
20
29
29
22
24
16
20
12
10

FIG.1D

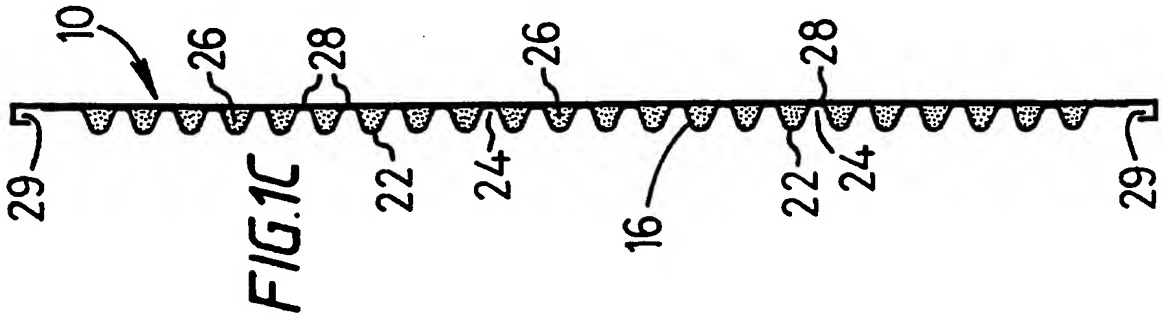

10
26
28
26
28
29
22
24
16
22
24
29

FIG.1C

FIG. 2A

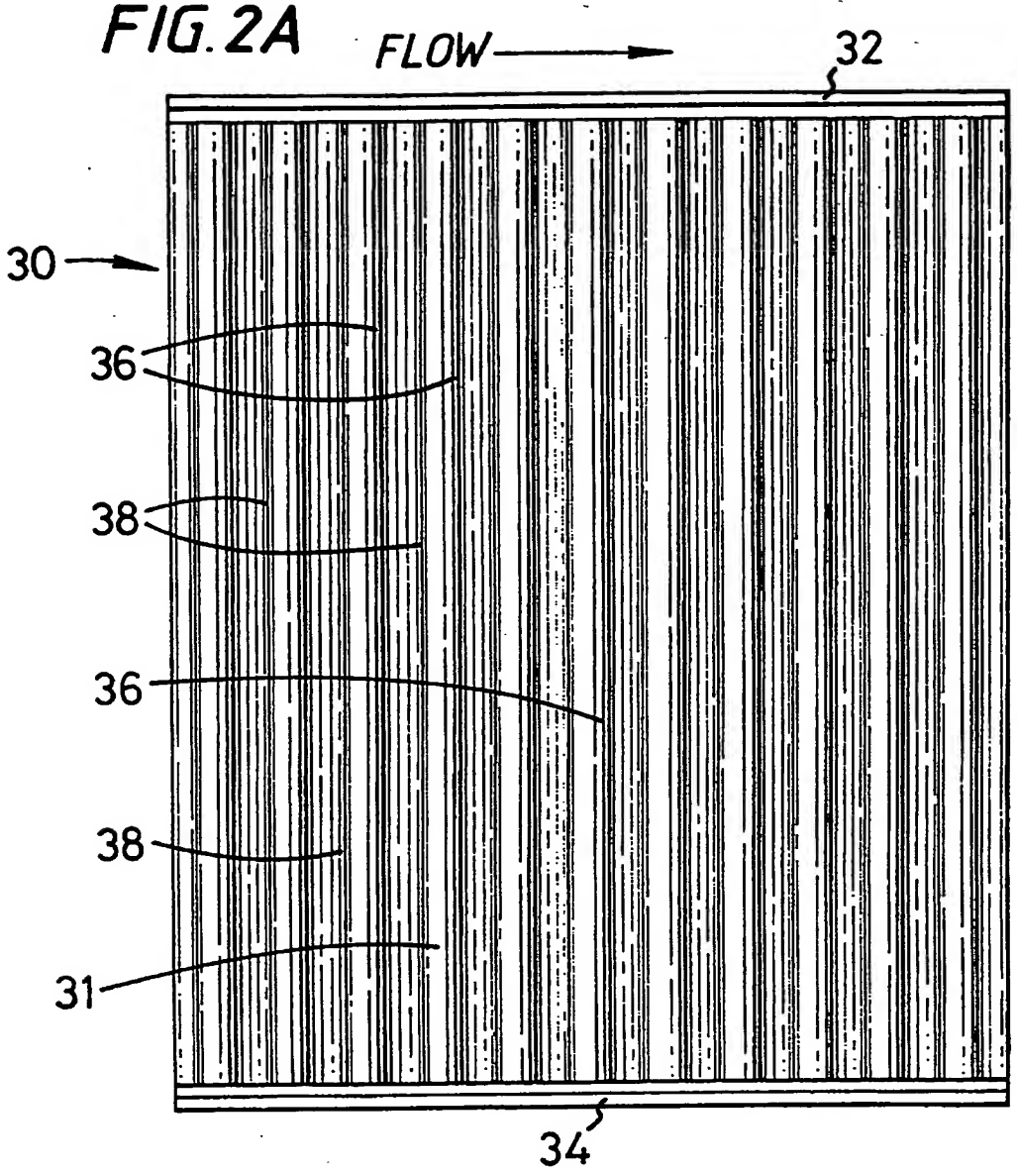


FIG. 2B

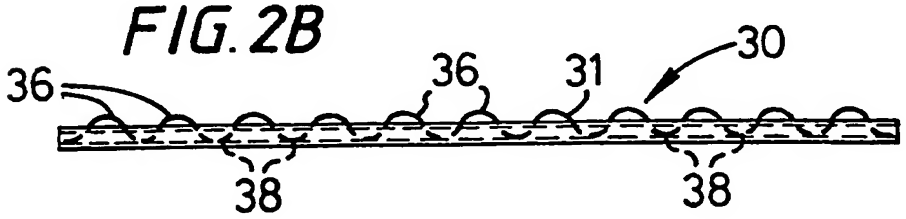
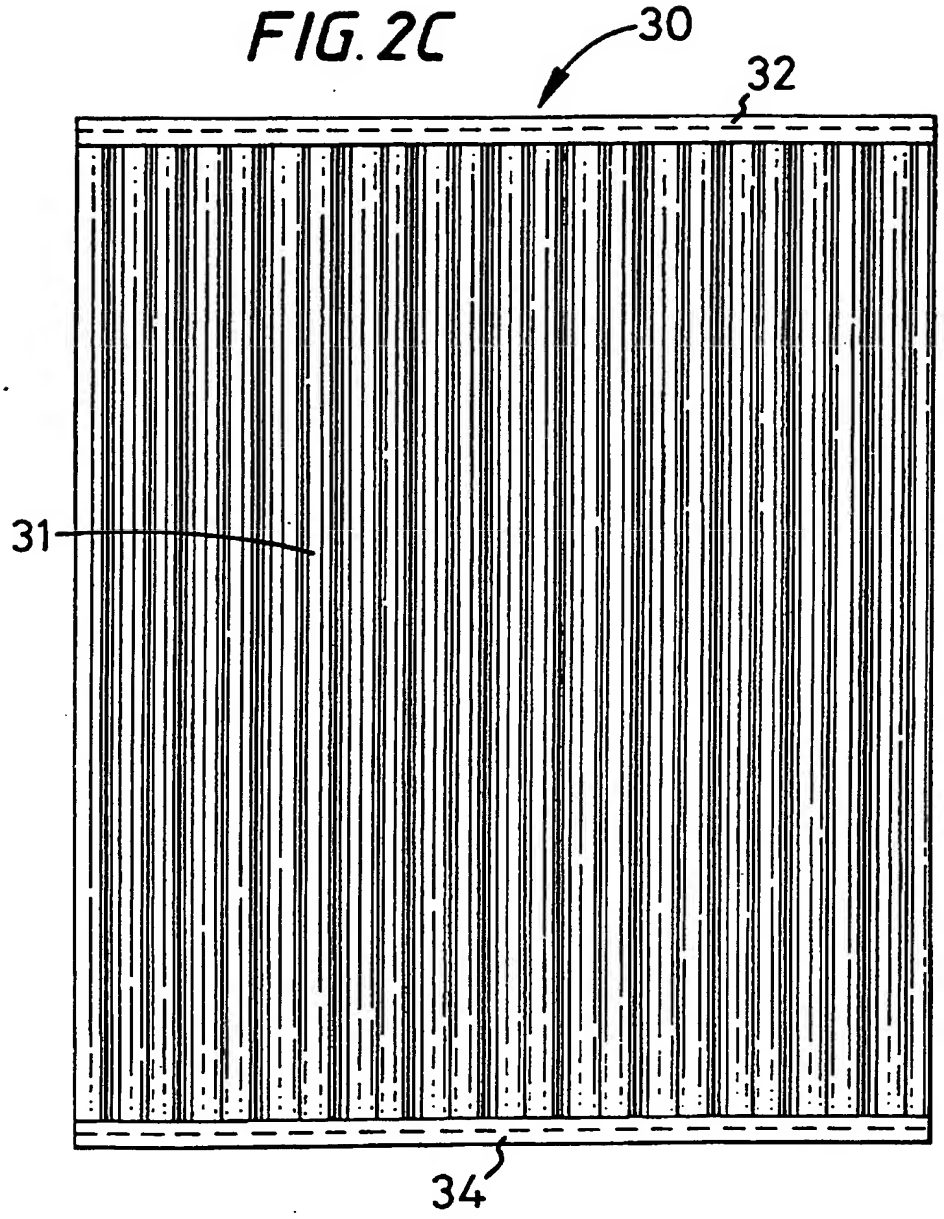


FIG. 2C



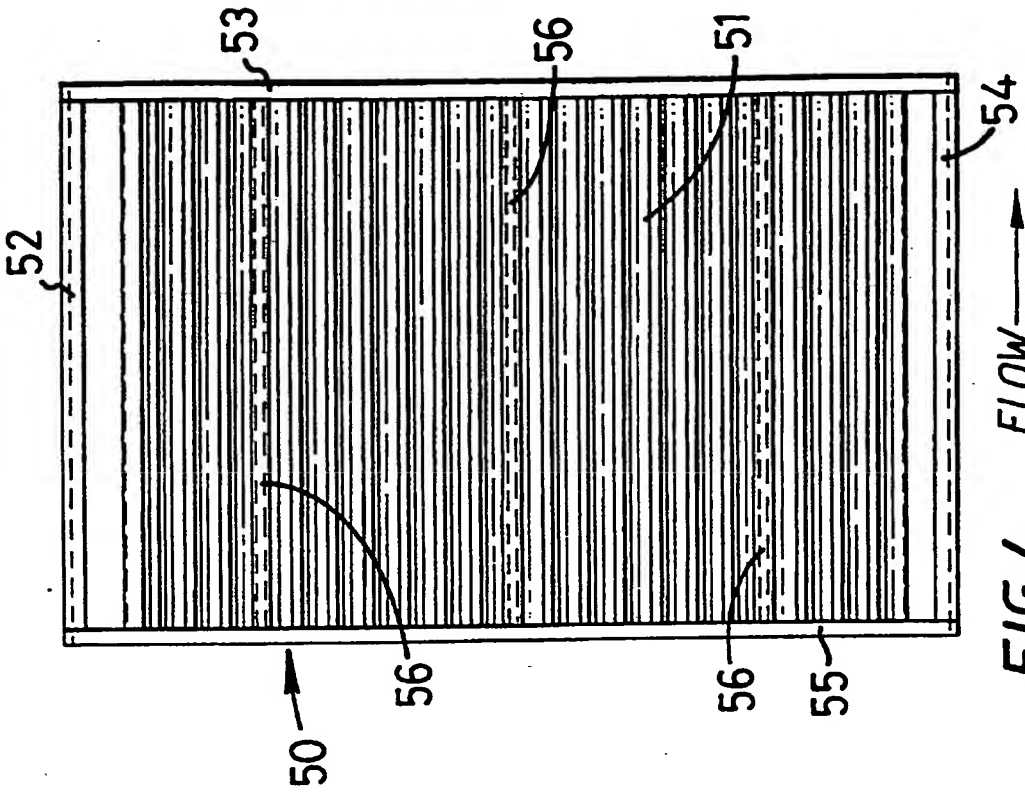


FIG.4

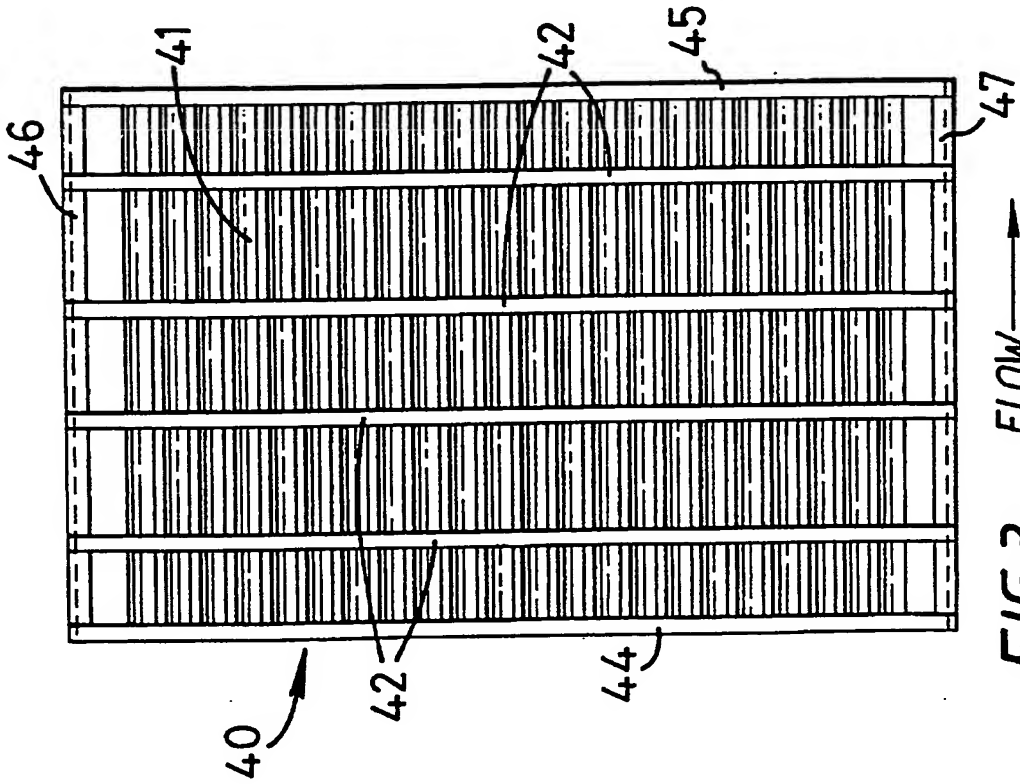


FIG.3

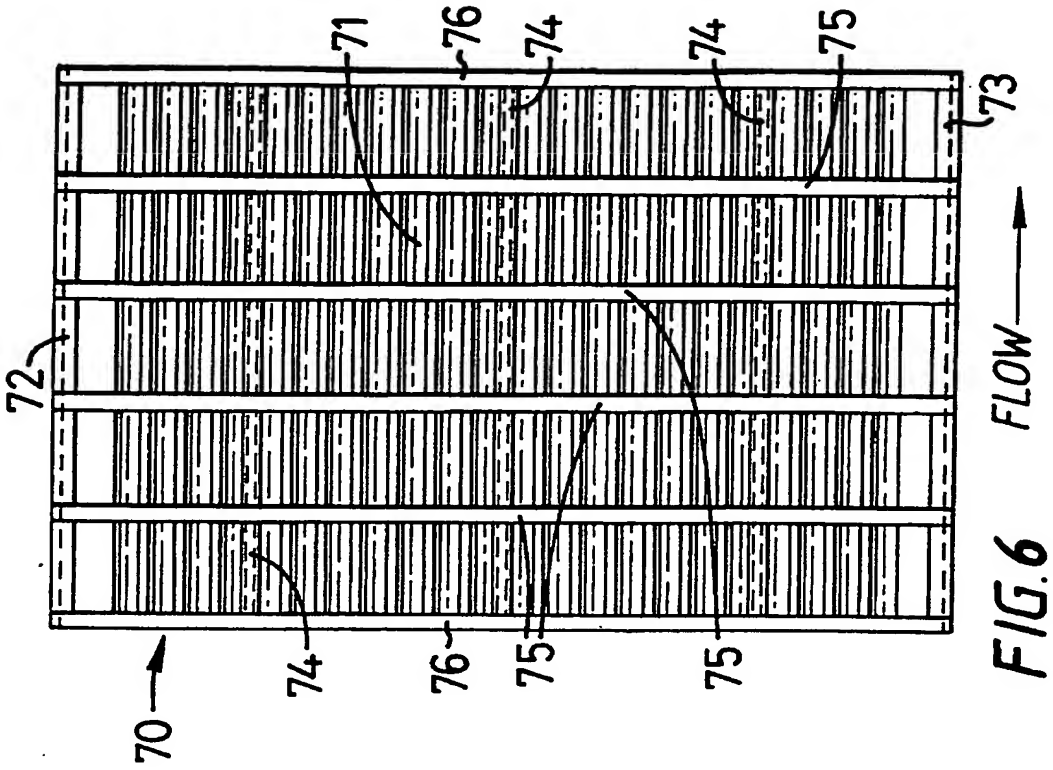


FIG.6

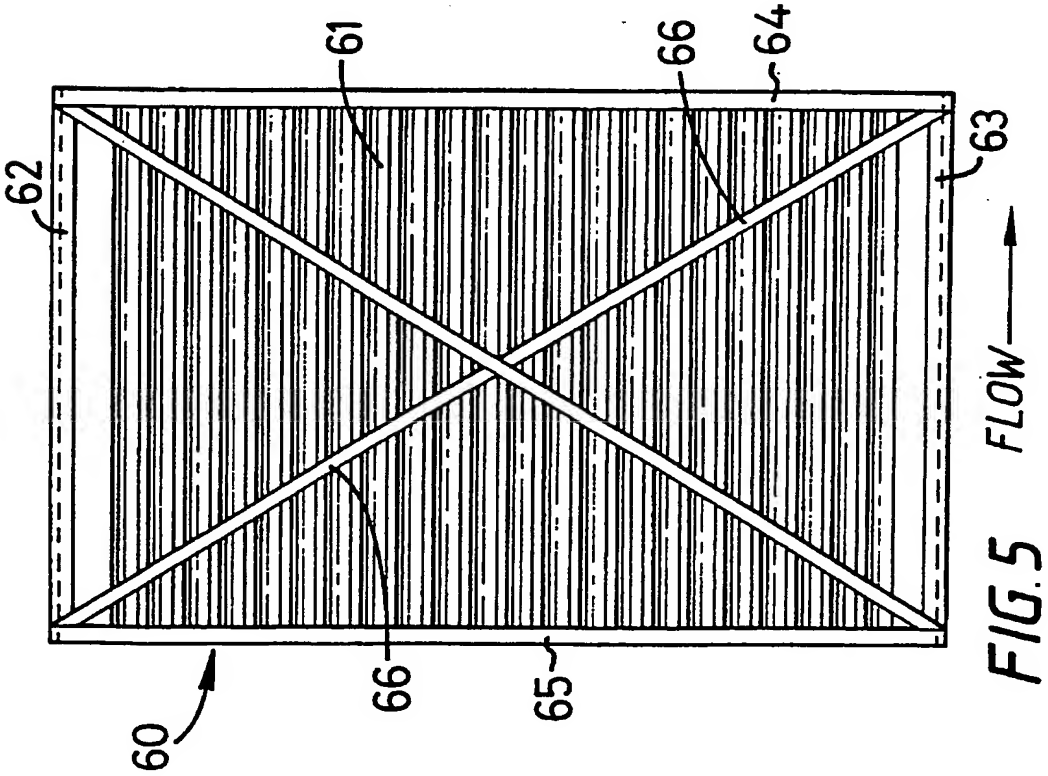


FIG.5

FIG.7A

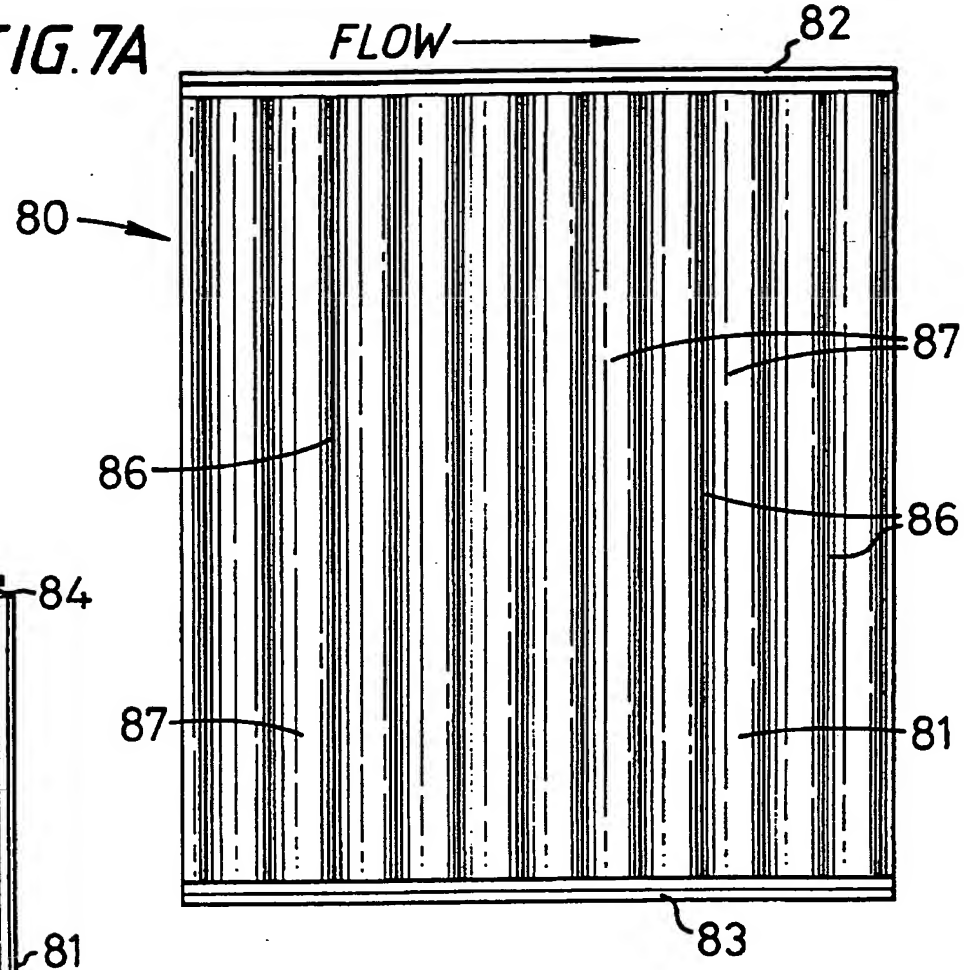


FIG.7C

FIG.7B

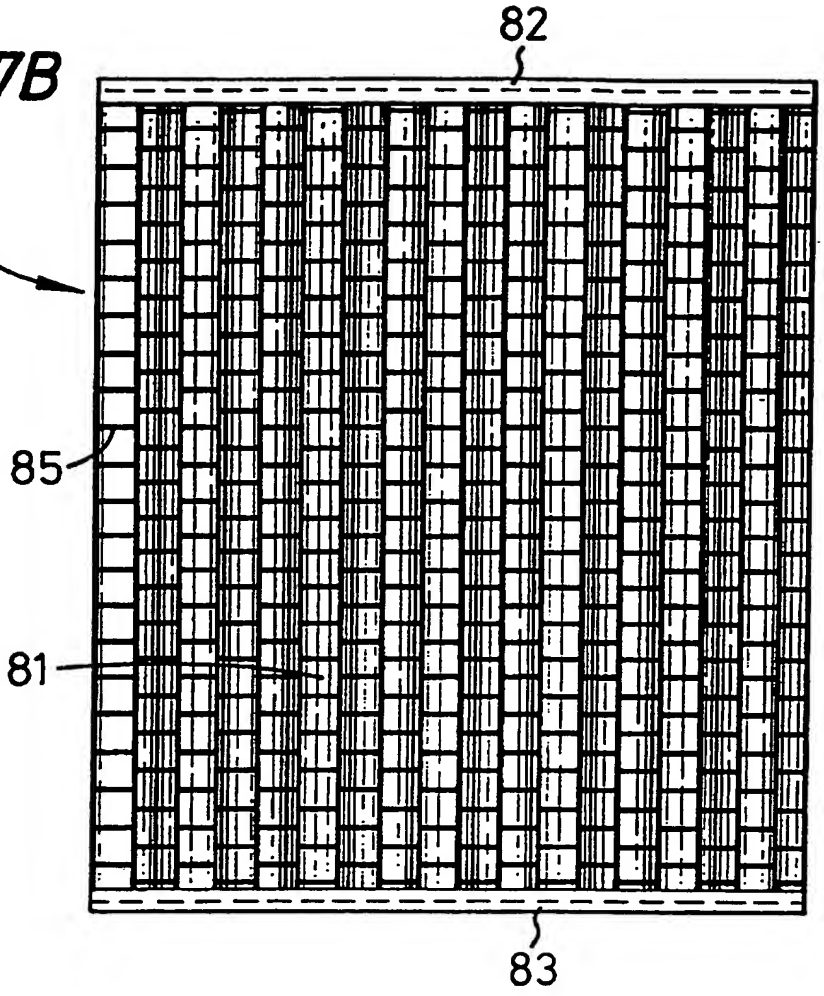
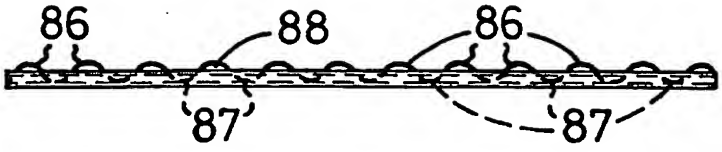


FIG.7D



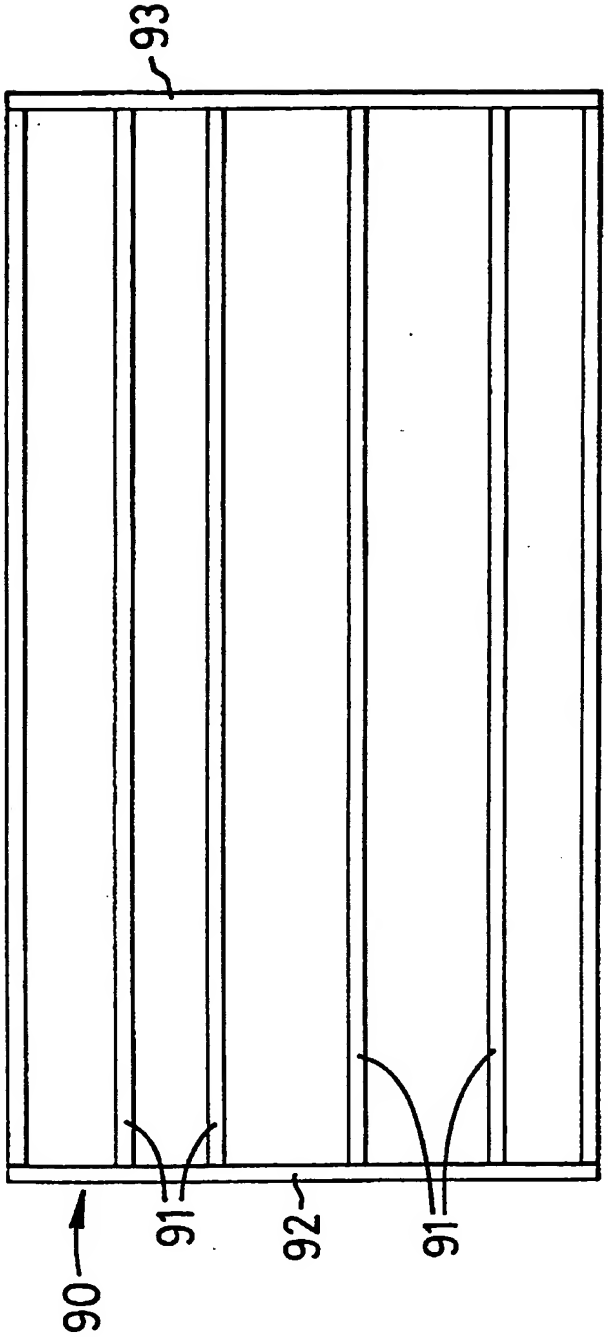


FIG.8A

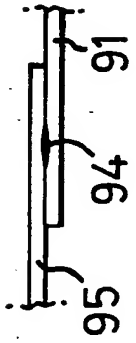


FIG.8C

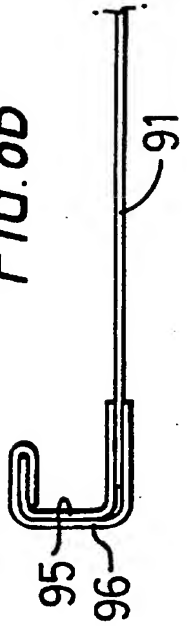


FIG.8B

FIG. 9

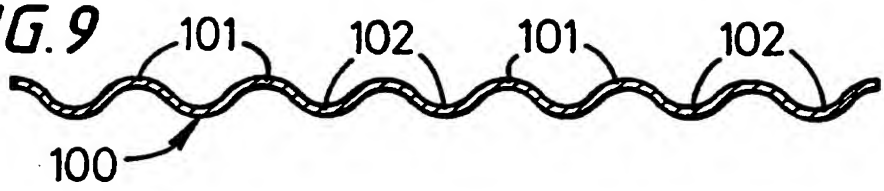


FIG. 10

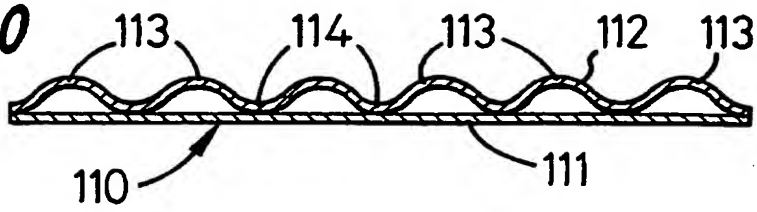


FIG. 11

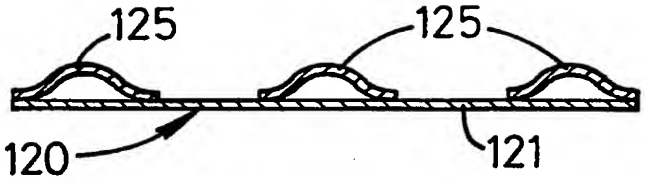


FIG. 12

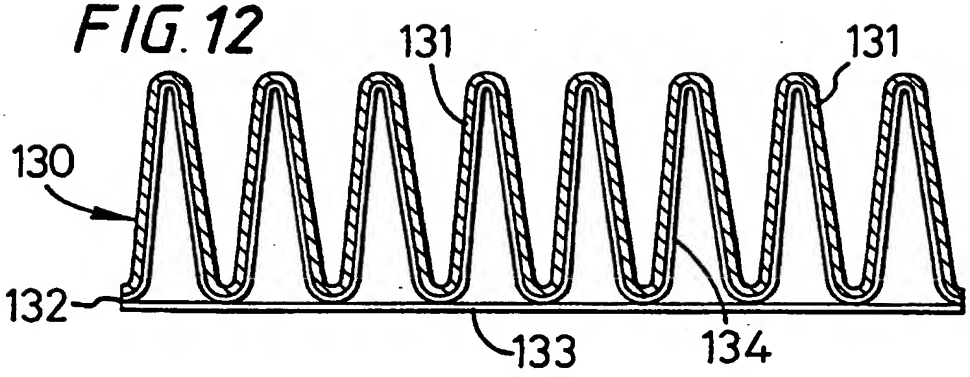


FIG. 13

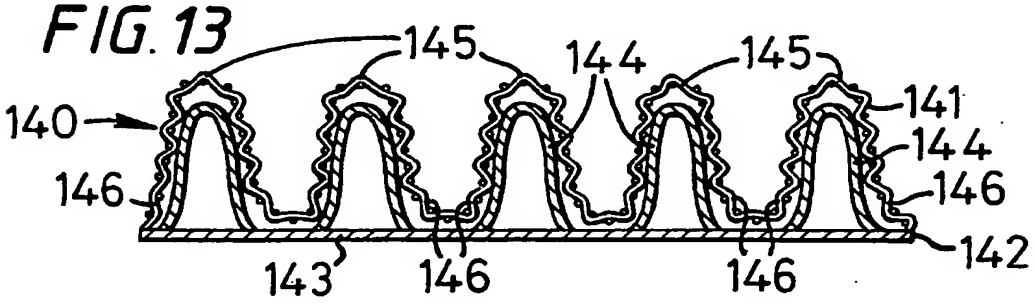


FIG. 14

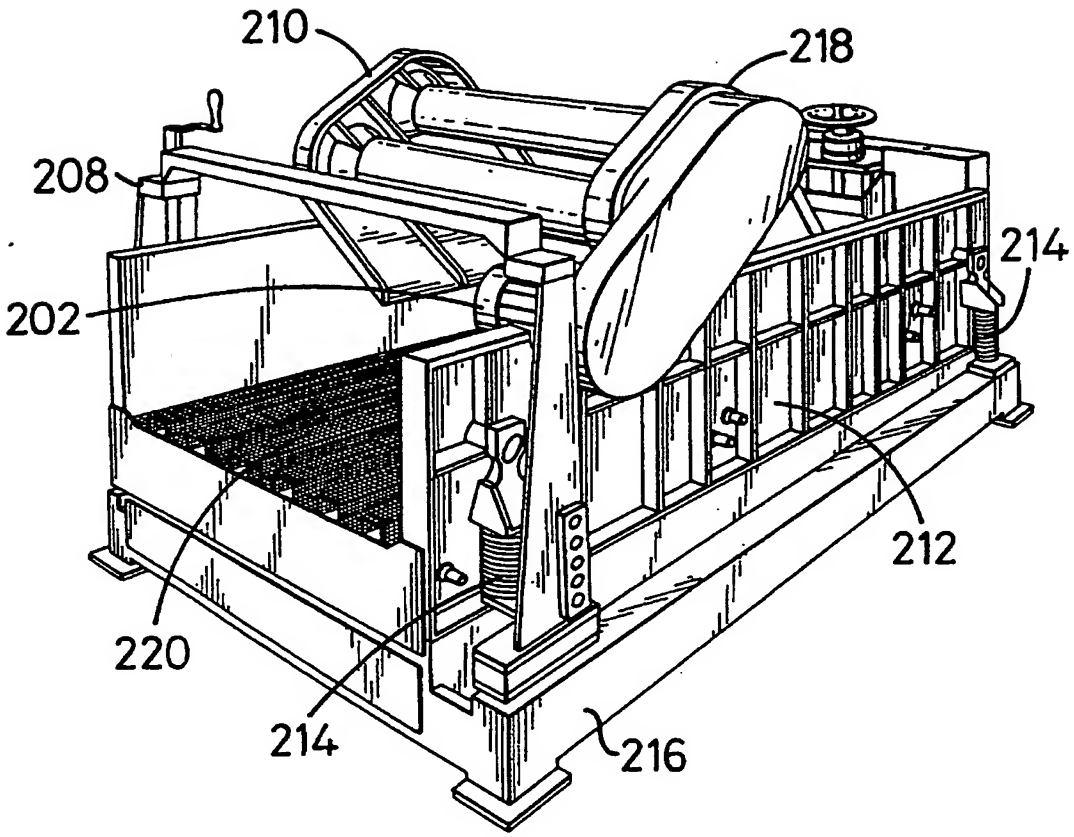


FIG. 15A

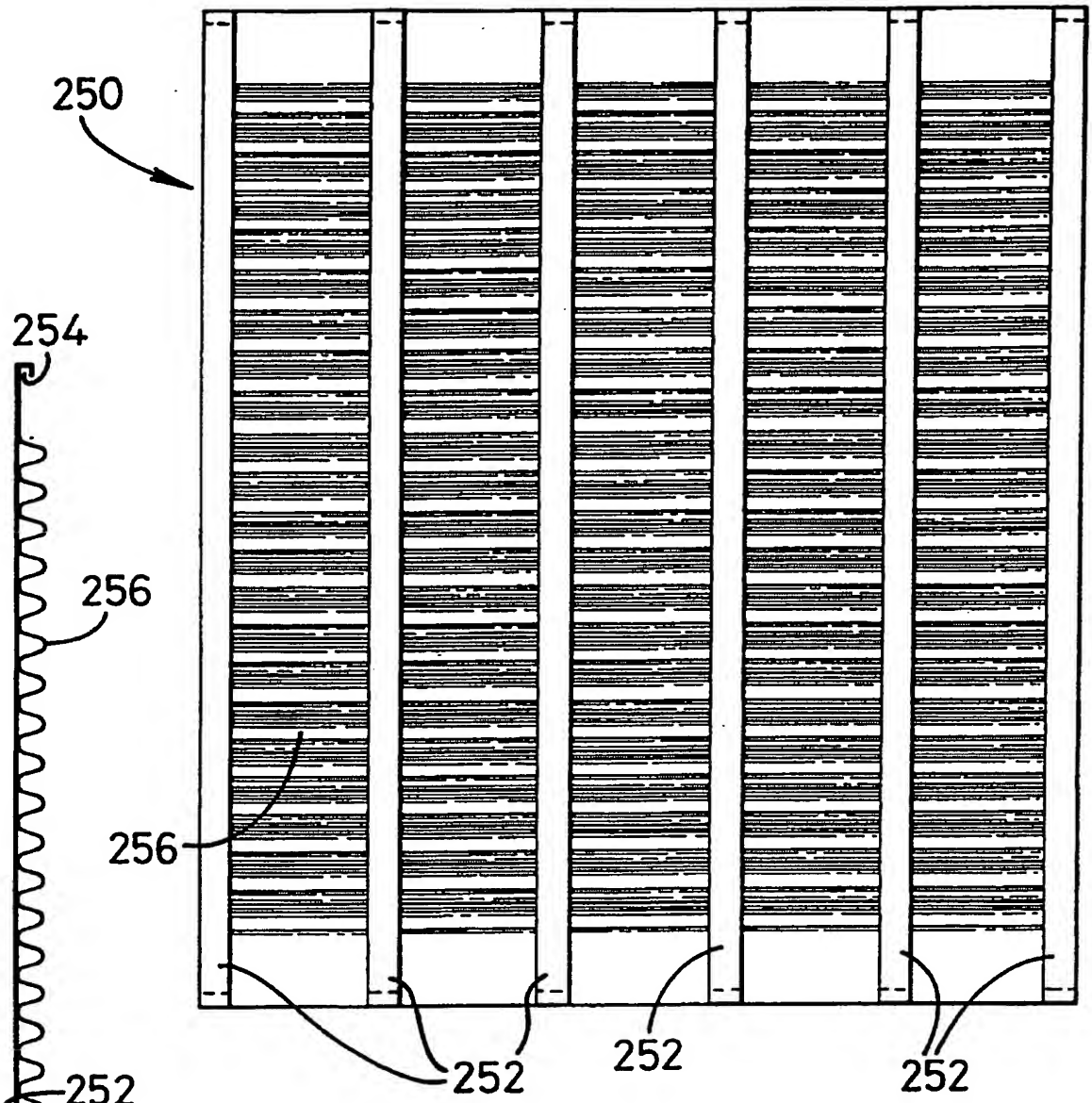


FIG. 15B

FIG.16A

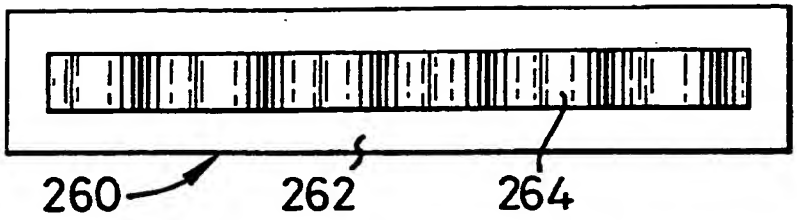


FIG.16B

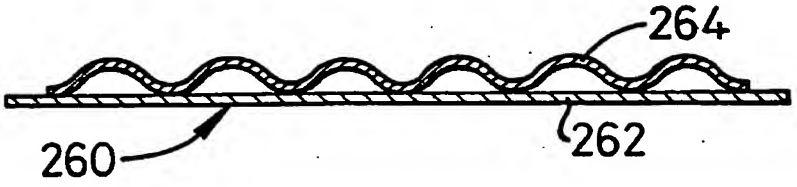


FIG.17A

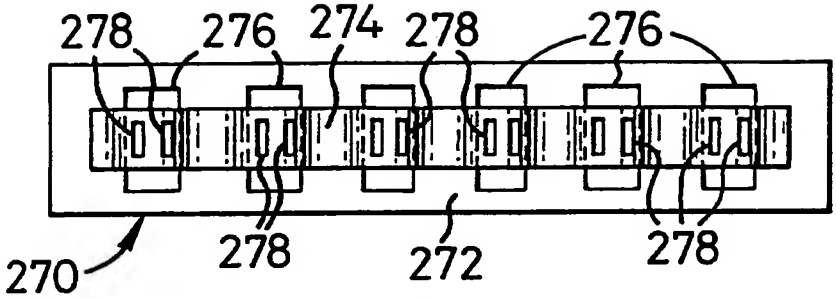


FIG.17B

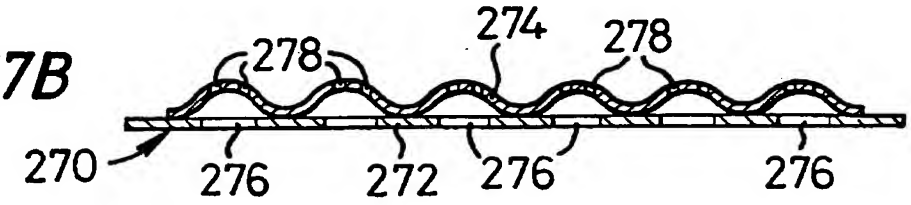
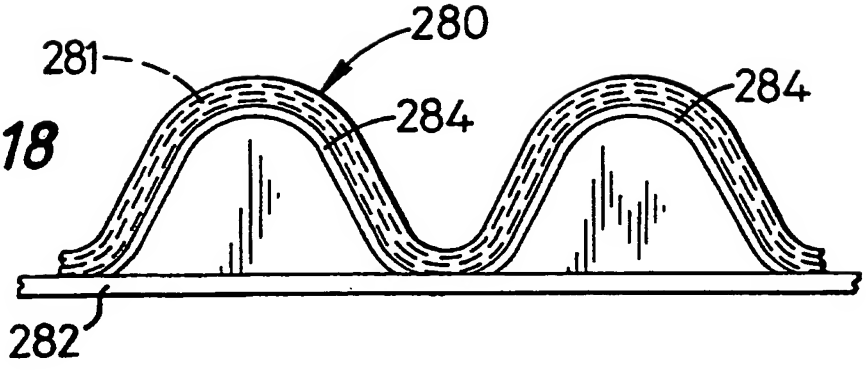


FIG. 18



INTERNATIONAL SEARCH REPORT

Inter. ial Application No
PCT/EP 96/03103

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B07B1/46 B01D29/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B07B B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR,A,2 407 026 (UNITED WIRE GROUP) 25 May 1979 see page 2, line 2 - line 12 see page 3, line 31 - page 4, line 4 see page 6, line 4 - line 19 see figures ---	1,2,6-8, 12,13,26
X A	US,A,5 417 858 (W. DERRICK) 23 May 1995 cited in the application see column 3, line 4 - column 5, line 15 see column 5, line 37 - line 68 see figures 1-8 --- -/--	1-9,11, 13,26,27 14,17, 18,25,27

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 October 1996	12.11.96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Laval, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte. nal Application No
PCT/EP 96/03103

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 100 132 (DEREK PARNABY CYCLONES) 8 February 1984	1-7,26, 27
A	see page 2, line 12 - page 5, line 4 see page 7, line 14 - page 10, line 7 see page 12, line 17 - page 13, line 8 see figures 1,2,7,8	14
A	US,A,4 380 494 (A. WILSON) 19 April 1983 see column 3, line 30 - column 4, line 43 see figures	1,14
A	GB,A,781 194 (R. WILLIAMS) 14 August 1957 see page 2, line 10 - line 106 see page 3, line 82 - line 116 see figures 1-4,8	1-7, 12-16, 25,26
A	DE,C,812 740 (P. RÖBER) 3 September 1951 see the whole document	28
A	GB,A,823 648 (AIR-MAZE CORPORATION) 18 November 1959	
A	US,A,3 255 885 (J. BURLS) 14 June 1966	
A	WO,A,94 23849 (ENVIRONMENTAL PROCEDURES) 27 October 1994	

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. al Application No
PCT/EP 96/03103

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
FR-A-2407026	25-05-79	GB-A-	1578948	12-11-80
		DE-A-	2846342	03-05-79
		JP-C-	1409284	24-11-87
		JP-A-	54074557	14-06-79
		JP-B-	62011911	16-03-87
US-A-5417858	23-05-95	AU-A-	6023194	15-08-94
		AU-A-	6084494	15-08-94
		CA-A-	2152602	21-07-94
		CA-A-	2152610	21-07-94
		EP-A-	0680386	08-11-95
		EP-A-	0680385	08-11-95
		WO-A-	9415723	21-07-94
		WO-A-	9415724	21-07-94
		US-A-	5417859	23-05-95
		US-A-	5417793	23-05-95
EP-A-100132	08-02-84	AU-B-	565220	10-09-87
		AU-A-	1358883	26-01-84
		CA-A-	1198988	07-01-86
		GB-A,B	2124099	15-02-84
US-A-4380494	19-04-83	AU-B-	544198	23-05-85
		AU-A-	6757481	22-10-81
		CA-A-	1157427	22-11-83
		DE-A-	3114573	08-04-82
		FR-A-	2480146	16-10-81
		GB-A,B	2073618	21-10-81
GB-A-781194		NONE		
DE-C-812740		NONE		
GB-A-823648		NONE		
US-A-3255885	14-06-66	NONE		
WO-A-9423849	27-10-94	US-A-	5385669	31-01-95
		AU-A-	6677594	08-11-94
		EP-A-	0693004	24-01-96

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. nal Application No
PCT/EP 96/03103

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9423849		NO-A- 952867	19-07-95

Form PCT/ISA/210 (patent family annex) (July 1992)